A Multi-Echelon, Multi-Product-Type, Site Selection and Inventory Allocation Supply Chain Model for Lean Facilities

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Abstract

Effective supply chain management in today's business world is considered a competitive advantage and supply chain managers today face a myriad of inter-related decisions ranging from inventory allocation to site selection to shipment scheduling. Unfortunately, most supply chain models consider such decisions independently, and therefore miss the effects of numerous tradeoffs. Managers thus face the lack of a tool by which they may evaluate the merits of novel integrative supply chain management paradigms such as lean logistics. Here, a mixed integer non-linear programming model was formulated for a supply chain with four echelons, each with multiple sites. The first echelon consisted of suppliers, then factories for the second echelon, down to depots and cross-docks in the third echelon, and finally, customers for the fourth echelon. The model made use of one-for-one base-stock replenishment policies for each facility and it is also considered different modes of replenishment from suppliers to factories, namely, the traditional direct replenishment and the lean logistics mechanisms Kanban and Constant Work-in-process or ConWIP. End-product demand generated by the customer echelon was modeled as stochastic. The objective was to maximize total system costs including capital and operating expenses, holding costs, transportation costs, and backorder costs. The decision variables involved selection of sites for factories, depots, and cross-docks, target inventory levels, replenishment frequencies and choice of pull system.